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2015 SEMINAR SERIES PRESENTS

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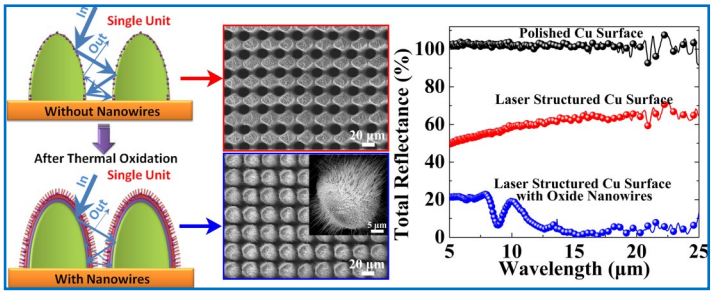
Ultrafast laser enabling versatile novel micro-nano scale materials processing

Ultrafast laser, with ultra-short pulse duration and ultra-high energy density, is an emerging powerful and advanced tool for micro-nano scale materials processing. The unique features when an ultrafast laser interacts with materials include: (1) beyond the diffraction limit via near-filed optics principle etc. to form sub-micro scale or nano-scale fabrication; (2) beyond the heat-affect zone limitation via extremely non-equilibrium energy transfer and dissipation to form high fabrication accuracy; and (3) materials independence via nonlinear effects like multi-photon absorption and avalanche ionization to process almost any kind of materials. In recent years, ultrafast lasers in sub-ps regime and MHz repetition rate deliver average power up to multi 100W and even over 1KW, which enables not only versatile micro-nano scale material processing for fundamental research, but also capable technologies for industrial applications.



This presentation reports our recent research by using high average power high repetition rate ultrafast lasers: (1) ultrafast laser enabling brand band anti-reflection surface micro-nano structures. On laser structured micro-nano Cu surfaces, we further introduce thermal oxidation to grow a kind of macro-micro/nano-nanowire structure, showing a reflectance of 0.6% at infrared 17 μm and below 3% over 14−18 μm (Nano Letters, 8/2015). (2) ultrafast laser enabling flexible patterning and thinning of graphene with precise layer control. Desired number of layer was obtained by single process from original multi-layer graphene when appropriate pulse threshold energy was adopted (Scientific Report, 6/2016). (3) ultrafast laser enabling smart superhydrophobic surfaces. Almost any kind of metal or alloy surfaces and many organic materials can be structured to form superhydrophobicity, colorful superhydrophobicity and superhydrophocity with tunable adhesion (ACS Applied Materials & Interfaces, 4/2015; J. Colloid and Interface Science, 3/2015).

Minlin Zhong is professor and director of the Laser Materials Processing Research Centre at the School of Materials Science and Engineering of Tsinghua University. His research covers laser micro-nano fabrication, laser surface engineering and laser 3D printing. He has been PI for 19 international cooperation projects, 10 domestic fundamental research projects and 20 industrious projects. He has published 210 papers in peer review journals and 70 papers in international conferences. He has given over 40 plenary keynote, keynote and invited presentations. Dr. Zhong was elected a Fellow of Laser Institute of America (LIA) in 2010 and the president of the International Academy of Photonics and Laser Engineering in 2015. Currently he serves as a senior editor of "Journal of Laser Applications" and an editorial member of "Light: Science & Applications" (Nature Publication Group).

Thursday, October 15, 2:30 pm | 110 Jorgensen Hall

Host:
Professor Yongfeng Lu

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